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TOPIC Number: N92-023

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Contract Number: N00039-95-C-0019

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Proposal Title: Anti-Surface Warfare Tactical Decision Aid (ASVWTDA)

Principal Investigator Name: Dr. Joseph H. Discenza

Principal Investigator Phone: ~~804~~-727-7700

Firm

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Woman Owned: N
Minority Owned: N
Number of Employees: 65

Keywords: ANTI-SURFACE WARFARE DECISION AID

Abstract: The proposed research and development will provide a cohesive module for NTCS-A/JOTS that will support the ASUW commander in all phases of planning and decision making. In Phase I, we developed the requirements and a prototype user interface working within the NTCS-A environment. In Phase II, Wagner proposes to integrate existing software more completely and to develop new software modules as well. The innovations are (1) the ability to organize, via a cohesive set of menus and windows, all the decision aid requirements for ASUW support, and (2) the use of a sophisticated, non-linear target model based on Monte Carlo methodlogy for contact management and correlation, target information fusion and localization, and engagement planning. This will be the only system capable of providing accurate localization and targeting in the constricted waters of the littoral zone.

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REPORT DOCUMENTATION PAGE

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6. AUTHOR(S)
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8. PERFORMING ORGANIZATION REPORT NUMBER
Case 6060
Final Report

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13. ABSTRACT (Maximum 200 words)

Report developed under SBIR contract for topic N92-023. In this project we developed a tactical decision aid for planning non-acoustic searches against surface ships and submarines. Build One has been integrated as a segment of the Global Command and Control System-Maritime (GCCS-M), and is deployed with several carrier battlegroups. ASUWTDA has received high praise in official traffic from flag level warfare commanders and has helped plan highly successful exercise operations. Build One handles only uncued search (clearance) but cued search is planned for Build Two. ASUWTDA maintains comprehensive databases for Navy platforms and sensors and automatically generates an optimal, multiple-sortie plan for an entire day in a single step. Optimization algorithms account for the special nature of the uncued surveillance problem, and adjust for the need for targets to be relocated and loosely tracked. Once a plan is developed, detailed track leg information can be exported to other systems. If necessary, the operator has the opportunity to replan a portion of the day's mission. ASUWTDA provides a two-dimensional "clearance map" which shows search effectiveness throughout the area of interest and an "effectiveness graph" which shows search effectiveness over time in the zones of interest.

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February 23, 1998
Origination: Hampton
Case: 6060

MEMORANDUM

To: Space and Naval Warfare Systems Command
Attn: PMW 171-2, Mr. Bill Josey

From: Dr. W. Reynolds Monach

Subject: Final Report for Contract N00039-95-C-0019

Daniel H. Wagner Associates, Inc. provides this report in accordance with CDRL A002 of the subject contract.

1. Introduction

In this Phase II SBIR project, Wagner successfully completed the development of Build 1.0 of the Anti-Surface Warfare Tactical Decision Aid (ASUWTDA) JMCIS segment and successfully introduced it to fleet users. A version of ASUWTDA Build 1.0 compatible with DII COE 3.0.2.5 was also delivered to NRaD for the JMCIS 98 OPEVAL. ASUWTDA Build 1 provides an automated tactical decision aid to assist the fleet planner in carrying out the non-acoustic Surface Warfare (SUW)/Undersea Warfare (USW) area surveillance planning process diagrammed in Figure 1.

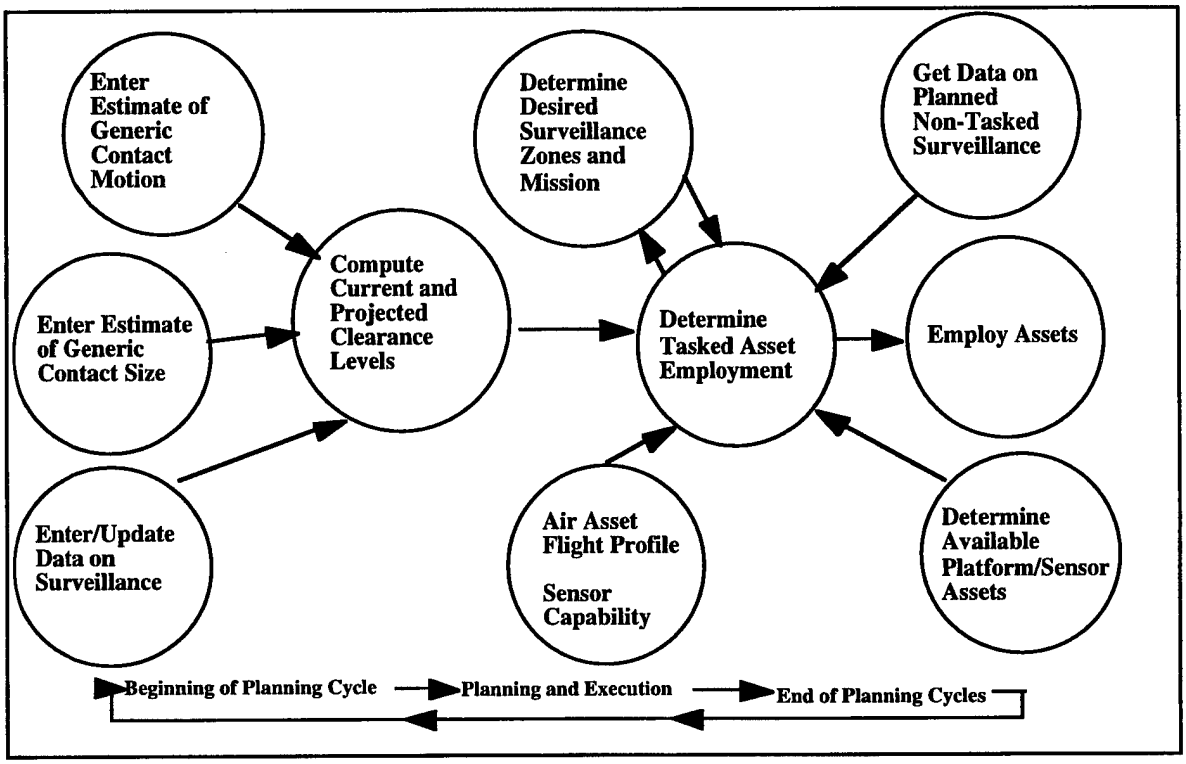

Figure 1. Non-Acoustic SUW/USW Area Surveillance Planning Process

ASUWTDA Build 1 (1) provides sortie-level planning, (2) generates recommended search plans, and (3) evaluates overall surveillance effectiveness. The principle ASUWTDA outputs are (1) recommended search assignments, (2) a clearance map which shows the effectiveness of the area surveillance efforts at a time of interest, (3) a timeline which shows the effectiveness of the area surveillance efforts over a 24 hour period, (4) a table showing the effectiveness of each individual search asset, and (5) graphical displays of the location of each search asset.

ASUWTDA Build 1 includes such important littoral considerations as (1) high shipping density, (2) contact diversity, (3) threat bases, (4) territorial stand-offs, and (5) multiple high-interest zones.

When evaluating and optimizing search effectiveness, ASUWTDA uses multiple databases. These consist of databases which are rarely changed, and databases which can be updated daily depending on the tactical situation. The databases which are rarely changed are (1) own-force sensor types, (2) own-force sensor capabilities (in day, night, poor weather, and user-defined conditions), (3) own-force aircraft types, (4) own-force aircraft flight profiles, (5) own-force aircraft assets (with non-acoustic sensors), (6) battlegroup surface and subsurface assets (with non-acoustic sensors), (7) territorial stand-off ranges,

(8) historical shipping densities, and (9) generic target sizes. ASUWTDA is delivered with default versions of these databases, and the classified version of the ASUWTDA system comes with default sensor capability and flight profile databases built using data from SECOND FLEET and THIRD FLEET surface surveillance TACMEMOs and TACNOTEs. The operator can generate variations for each of these databases based on experience, observation, or assigned forces. Newly generated databases do not affect default databases. The databases which may be changed daily by the operator are (1) contacts-of-interest in which the operator selects the smallest-sized contact that will be the object of searches and defines its motion parameters, (2) zone package in which the operator identifies zones that are to be searched, (3) carrier cycles, and (4) projected intended movements (PIMs).

ASUWTDA Build 1 was developed with the close cooperation of personnel from SPAWAR PMW-171, NISE East, Norfolk area commands such as CINCLANTFLT, SECOND FLEET, AIRLANT, TACTRAGRULANT, and SWDG; the George Washington, Enterprise, and Kennedy battlegroups; and several east coast destroyer squadrons (DESRONs). The extensive involvement of fleet personnel, beginning with the design of the Graphical User Interface and databases, and continuing through operational test of the system aboard the USS Kennedy, USS John Rodgers, USS George Washington and other ships, allowed us to develop a tactical decision aid for non-acoustic search which could be used effectively by fleet operators to evaluate and optimize non-acoustic search operations against both surface ships and submarines. Both COMJFKBATGRU (COMDESRON 24) [1-2] and COMDESRON 14 [3-4] wrote and sent very favorable lessons learned messages. Portions of these messages are contained in Figures 2 and 3, and the entire DESRON 14 301322Z SEP 97 message is contained in Appendix A.

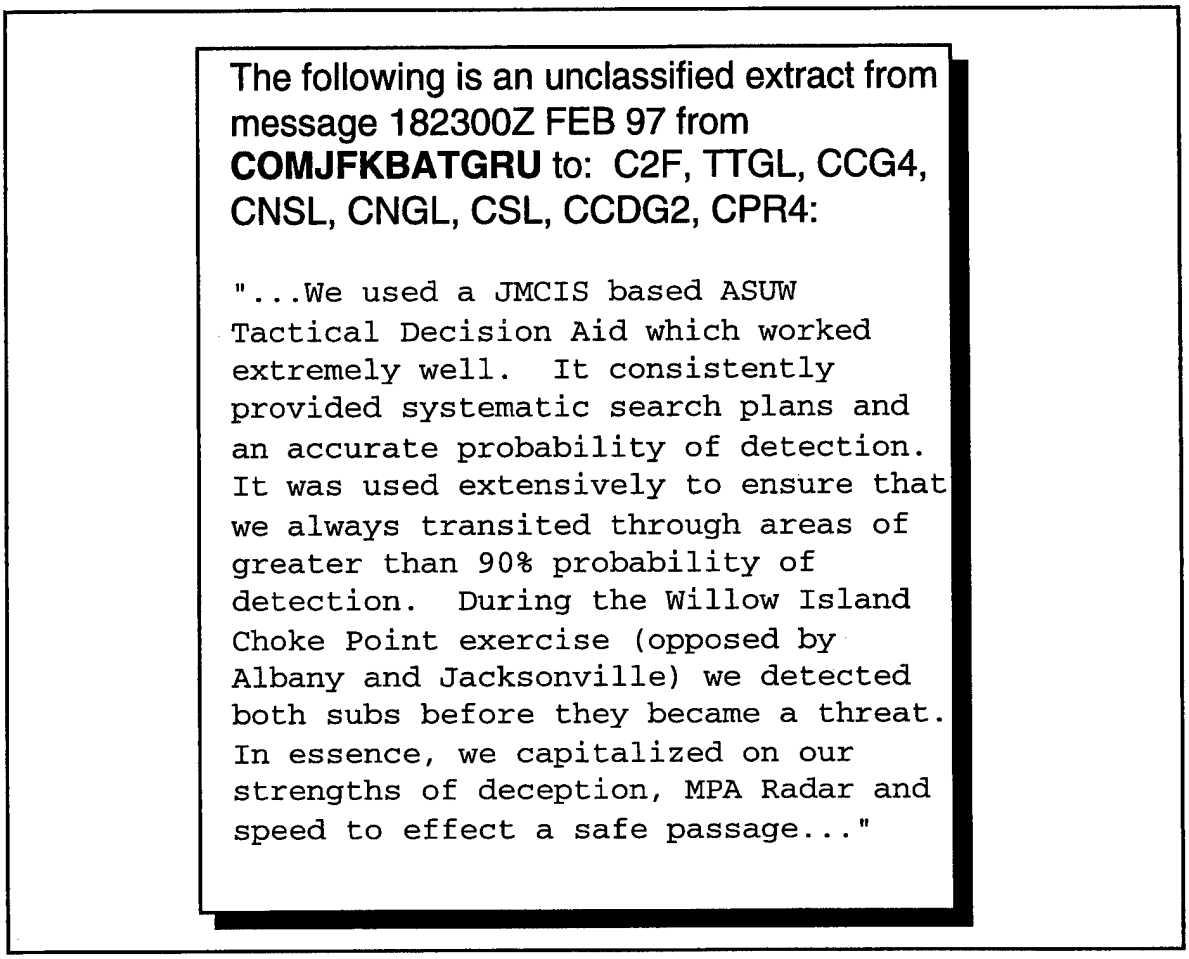
The following is an unclassified extract from message 182300Z FEB 97 from **COMJFKBATGRU** to: C2F, TTGL, CCG4, CNSL, CNGL, CSL, CCDG2, CPR4:
"...We used a JMCIS based ASUW Tactical Decision Aid which worked extremely well. It consistently provided systematic search plans and an accurate probability of detection. It was used extensively to ensure that we always transited through areas of greater than 90% probability of detection. During the Willow Island Choke Point exercise (opposed by Albany and Jacksonville) we detected both subs before they became a threat. In essence, we capitalized on our strengths of deception, MPA Radar and speed to effect a safe passage..."

Figure 2.

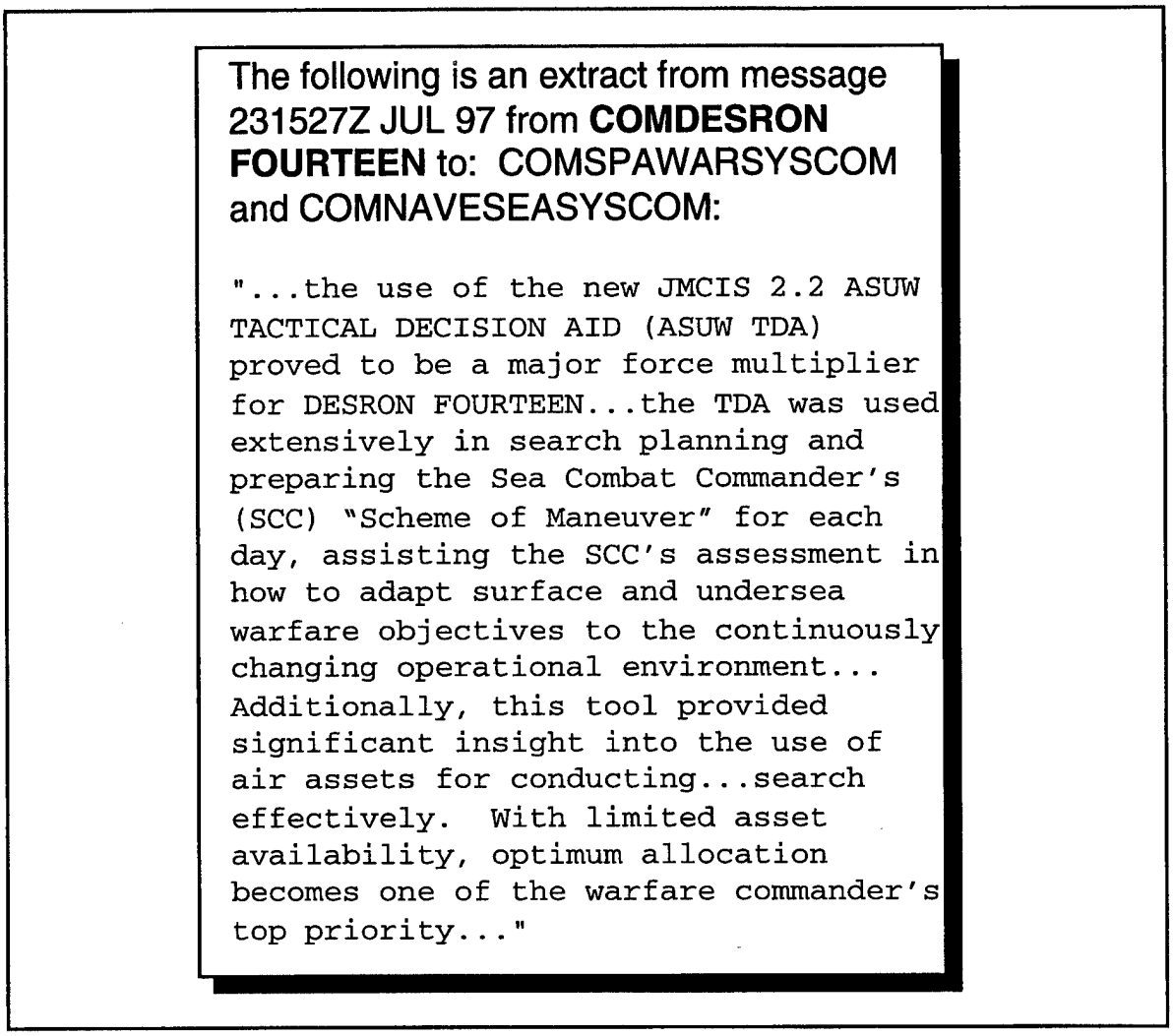

Figure 3.

As part of the ASUWTDA development process, and based on our work with fleet users, we produced a Training Manual [5], a Functional Description [6], a Standard Operating Procedures Manual [7], a User's Guide [8], and an Installation Guide [9]. The Training Manual uses a programmed instruction format which covers all of the key operational topics which might arise when running ASUWTDA. The goal of the Training Manual, which is to provide an introduction to program use in 2 hours, and program familiarity after 6 additional hours, appears to have been achieved. DESRONs 2 and 22 successfully used the Training Manual as their primary ASUWTDA training tool. The battle problems in the Training Manual: MODLOC (SUW and USW), Moving PIM (SUW and USW), and Choke Point Transit (USW), cover all of the mission planning scenarios which occurred during the USWPTs, COMPTUEXs, and JTFEXs in which the Kennedy and George Washington

battlegroups participated, and we believe that they cover the basics of any scenario which would arise during the deployment of a battlegroup.

2. Example of ASUWTDA Operation

The following provides the situation, goal, and operator tasking for a sample scenario:

- Situation:
  - Libya threatens Egypt
  - Enterprise battlegroup moves to support possible strike against Libya
  - Current Time: 010200Z MAY 96
- Goal:
  - Protect battlegroup against attack by surface threats
  - Maintain surveillance on Tripoli and Benghazi
  - Contacts of Interest (COIs) are large patrol boats and ships (90 feet+)
- Operator Tasking
  - Classify all surface contacts in the areas of interest within the last 3 hours
  - Create optimal sortie plan for available S-3s, P-3s, and LAMPS to achieve SUW mission goal.

Figure 4 shows a list of the aircraft available for SUW search during the period of interest. The two E-2 sorties have low-boys which will classify surface units in the E-2s' area, but the SUWC cannot change their areas. The S-3, P-3, and LAMPS sorties have been optimized to maximize the probability of classifying targets the size of large patrol boats in the areas of interest (within 50 NM of the battlegroup and near Tripoli and Benghazi). Figure 5 shows the details concerning the first S-3 sortie including its sensors and their effectiveness, the on- and off-station times, track spacing, and probability of success against a target of the specified size which was in the S-3's search area during the entire time the S-3 was on station. Figure 6 is a graphical representation of clearance effectiveness at 1300 and of the areas of interest and the sortie search areas. It also shows territorial stand-offs and threat bases. Figure 7 is a timeline showing the probability over time of having classified a large patrol boat in the areas of interest within the last 3 hours. Note that the originals of Figures 6 and 7 are in color and easily read and understood, which may not be true of the copies in this report, especially if they are black and white reproductions.

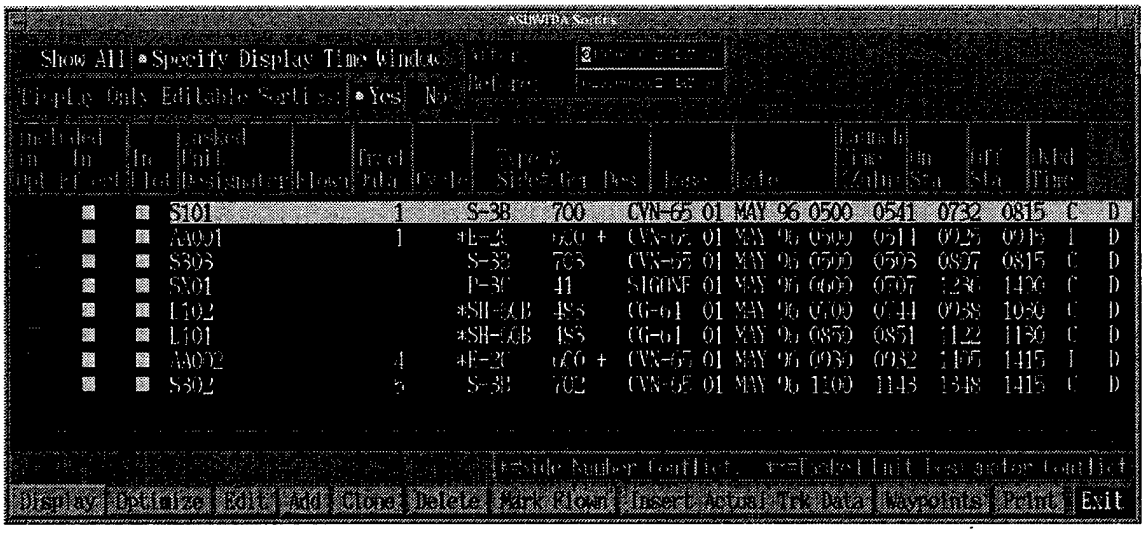

Figure 4. ASUWTDA Sortie List

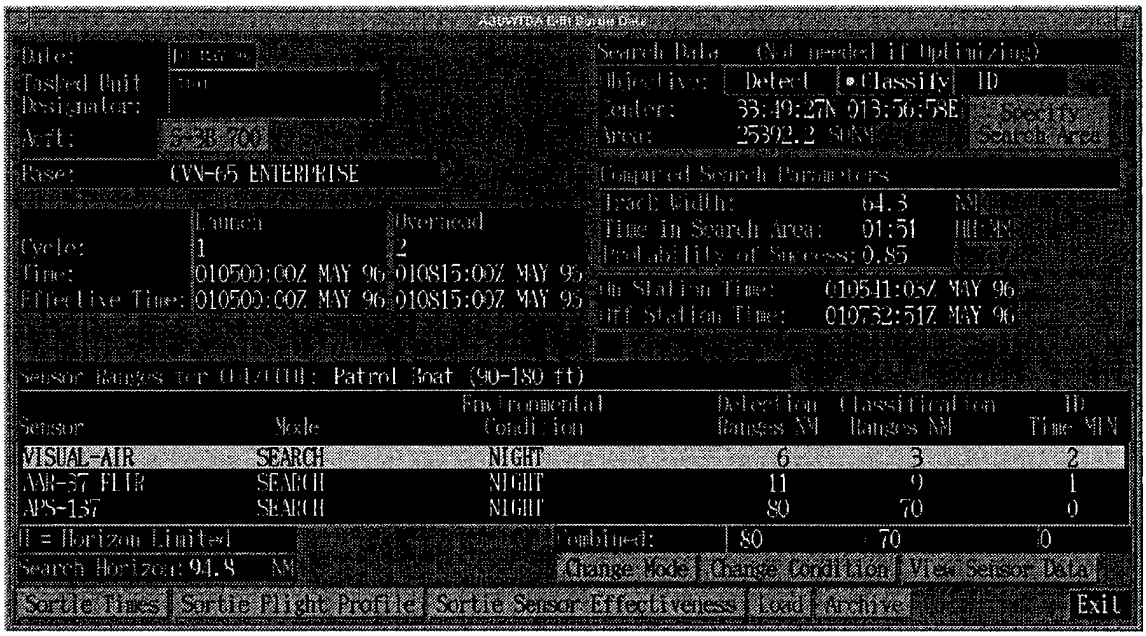

Figure 5. ASUWTDA Detailed Sortie Screen

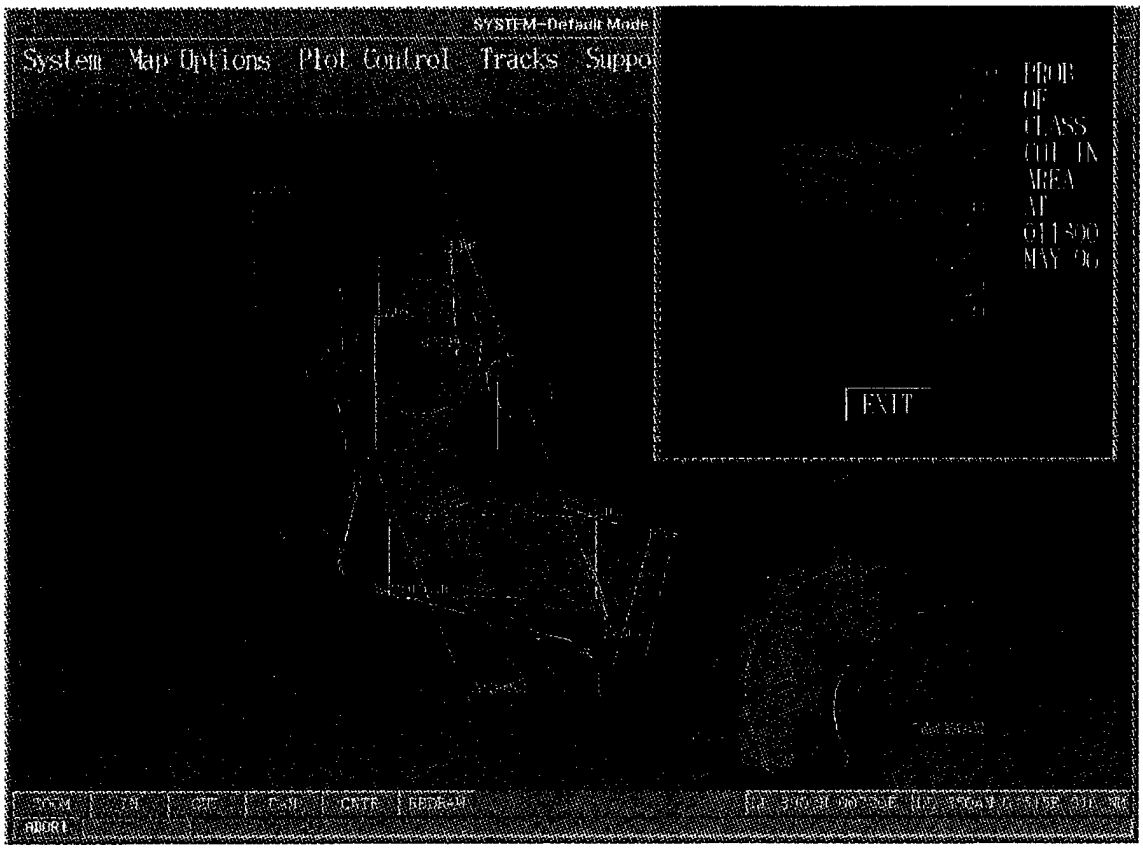

Figure 6. ASUWTDA Clearance Map

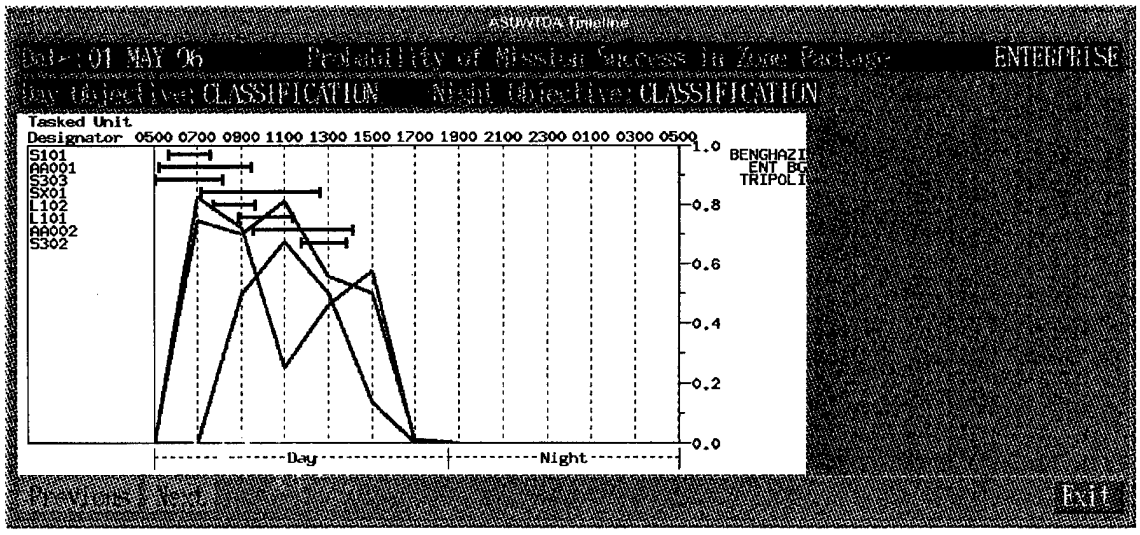

Figure 7. ASUWTDA Timeline

3. Future Plans

Integrate ASUWTDA into the Multi-Warfare TDA being developed under the direction of Dr. Asa Davis of NUWC.

Continue to work with Second Fleet and CINCLANTFLT to obtain funding for the continued support, maintenance, and enhancement of ASUWTDA. In particular, we will seek funding to fully implement directed search capability; enhanced JMCIS integration to allow communication between ASUWTDAs on different ships, and access to JMCIS PIMs, 4Ws, and Overlays; asset requirement recommendations to allow the fleet operator to easily determine how many assets are necessary to attain a certain mission goal; and algorithms to support targeting, BDA and other mission areas examined in Phase I [10]. We also plan to incorporate the ability to assign different mission goals (detection, classification, or identification) to scenario zones of interest; to prioritize zones based on operator specified criteria; and to incorporate no-fly areas based on surface-to-air missile sites or other pertinent factors.

References

[1] COMDESRON 24 Lessons Learned Message, COMJFKBATGRU 182300Z FEB 97.

[2] COMDESRON 24 Lessons Learned Message, COMDESRON TWO FOUR 032045Z APR 97.

[3] COMDESRON 14 Lessons Learned Message, COMDESRON FOURTEEN 231527Z JUL 97.

[4] COMDESRON 14 Lessons Learned Message, COMDESRON FOURTEEN 302213Z SEP 97.

[5] "Antisurface Warfare Tactical Decision Aid (ASUWTDA) Build 1 Training Manual", by Daniel H. Wagner Associates, Inc., August 1997.

[6] "ASUWTDA JMCIS Segment Statement of Functionality", Daniel H. Wagner Associates, Inc. and Delex Systems, Inc. report to Space and Naval Warfare Command, PMW 171-11D, October 2, 1996.

[7] "Antisurface Warfare Tactical Decision Aid (ASUWTDA) Build 1 Overview and Standard Operating Procedures", by Daniel H. Wagner Associates, Inc., September 1997.

[8] "Antisurface Warfare Tactical Decision Aid (ASUWTDA) Build 1 User's Guide", by Daniel H. Wagner Associates, Inc., August 1997.

[9] "Antisurface Warfare Tactical Decision Aid (ASUWTDA) Build 1 Installation and Tape Drive Casualty Procedures", by Daniel H. Wagner Associates, Inc., October 1997.

[10] "Anti-Surface Warfare Tactical Decision Aid (ASUWTDA) Research and Development", Phase I Final Report to Naval Surface Warfare Center - Dahlgren Division, by Daniel H. Wagner Associates, Inc. and Delex Systems, Inc., April 22, 1993.

W. Reynolds Monach

Appendix A

COMDESRON FOURTEEN 302213Z SEP 97

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FM COMDESRON FOURTEEN
TO RULSSBF/PEO UNSEAWAR WASHINGTON DC//JJJ///
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RULSSPA/COMSPAWARSYSCOM WASHINGTON DC//PMW171/PMW185//
RUWFADV/COMSPAWARSYSCOM WASHINGTON DC//PMW171/PMW185//
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RHFJBRQ/NISEEAST CHARLESTON SC//61//
RULSFAO/PEOASWASM PATUXENT RIVER MD//JJJ//
RULSACW/NAVSURFWARCENDIV DAHLGREN VA//T30//
RUDJABE/NAVUNSEAWARCENDIV NEWPORT RI//2211//
RUCOMAF/TACTRAGRULANT DAM NECK VA//JJJ//
RUWDHBS/TACTRAGRUPAC SAN DIEGO CA//JJJ//
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RULYVTA/COMGWBATGRU
DESRON FOURTEEN
BT
UNCLAS //N03200//
MSGID/GENADMIN/CDS14//
SUBJ/EMPLOYMENT OF JMCIS 2.2 ASUW TACTICAL DECISION AID//
RMKS/1. THE MESSAGE BELOW IS QUOTED FOR YOUR INFO. THE ASUW TACTICAL DECISION AID (TDA) IS HIGHLY RECOMMENDED AS PART OF THE STANDARD JMCIS INSTALLATION NAVY WIDE, AS IT CONTINUED TO BE AN EXCELLENT PLANNING AND ANALYSIS TOOL FOR CDS-14 DURING JTFEX 97-3. DURING THE EXERCISE, THE TDA WAS USED FOR THE FIRST TIME TO:
(A) DEVELOP UNCUED SEARCH PLANS FOR UP TO NINETY ATO SORTIES PER DAY
(B) PRODUCE SEARCH EFFECTIVENESS ANALYSIS AS IT RELATED TO THE EMPLOYMENT OF DIFFERENT SEARCH ASSET MIXES; AND
(C) COMPARE THE SEARCH EFFECTIVENESS OBTAINED BETWEEN THE CAPABILITY OF PLANNED SEARCH ASSETS AND THE ACTUAL CAPABILITY OF SEARCH ASSETS EMPLOYED. ADDITIONALLY, THE USE OF THE TDA HIGHLIGHTED THE NEED FOR ALGORITHMS FOR EVALUATING AND PLANNING DIRECTED (CUED) SEARCHES WHICH WOULD BE PARTICULARLY USEFULL AT REVISITING/RELOCATING CONTACTS OF INTEREST.
QUOTE
R 231527Z JUL 97 ZYB
FM COMDESRON FOURTEEN
TO COMSPAWARSYSCOM WASHINGTON DC//PMW171/PMW185//
COMNAVSEASYSCOM WASHINGTON DC//ASTO//
INFO COMGWBATGRU
UNCLAS //N03200//

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MSGID/GENADMIN//
SUBJ/EMPLOYMENT OF JMCIS 2.2 ASUW TACTICAL DECISION AID//
REF/A/CON/CDS14/21JUL97//
AMPN/PHONCON BETWN CDS14 AND DANIEL H. WAGNER ASSOCIATES.//
RMKS/1. AS DISCUSSED AND REQUESTED IN REF A, DURING USWPT/COMPTUEX PHASE I AND PHASE II, THE USE OF THE NEW JMCIS 2.2 ASUW TACTICAL DECISION AID (ASUW TDA) PROVED TO BE A MAJOR FORCE MULTIPLIER FOR DESRON FOURTEEN. THE TRAINING AND SUPPORT PROVIDED BY DR. W. REYNOLDS MONACH FROM DANIEL H. WAGNER ASSOCIATES WAS ALSO SUPERB. DESRON FOURTEEN STAFF RECEIVED EXCELLENT HANDS-ON TRAINING USING REAL LIFE DATA IN A DYNAMIC ENVIRONMENT. MORE THAN THAT, THE TDA WAS USED EXTENSIVELY IN SEARCH PLANNING AND IN PREPARING THE SEA COMBAT COMMANDER'S (SCC) "SCHEME OF MANEUVER" FOR EACH DAY, ASSISTING THE SCC'S ASSESSMENT IN HOW TO ADAPT SURFACE AND UNDERSEA WARFARE OBJECTIVES TO THE CONTINUOUSLY CHANGING OPERATIONAL ENVIRONMENT.
2. ADDITIONALLY, THIS TOOL PROVIDED SIGNIFICANT INSIGHT INTO THE USE OF AIR ASSETS FOR CONDUCTING SUW SEARCH EFFECTIVELY. WITH LIMITED ASSET AVAILABILITY, OPTIMUM ALLOCATION BECOMES ONE OF THE WARFARE COMMANDER'S TOP PRIORITY. THIS MODEL ENABLES THE SCC TO PROVIDE USEFUL ADVICE TO THE BATTLE GROUP COMMANDER BY ANALYZING THE POSSIBILITIES WHILE PRESENTING THE TRADE-OFFS OF EACH SEARCH OPTION.
3. DESRON FOURTEEN PLANS TO CONTINUE USING THIS EXCEPTIONAL TDA TOOL DURING JTF-EX AND DEPLOYMENT FOR THE PLANNING AND EXECUTION OF METHODICAL, MATHEMATICALY-BASED ANALYSES OF OUR SEARCH REQUIREMENTS. RECOMMEND CONTINUED DEVELOPMENT AND ENHANCEMENT OF THIS MODEL TO FURTHER ASSIST DECISION MAKERS AND THEIR UNDERSTANDING OF ITS OBJECTIVE APPROACH TO SEARCH PLANNING.
UNQUOTE//
BT
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RTD:000-000/COPIES:

***Office Codes that have received this message: ***

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002S	003A	003G	00S	01
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